Webinar Q&A

Zero Energy Schools: Toolkit and Exemplar Webinar

Question: How are the panels financed?

Response from HMFH Architects:

- The PV system at Fales Elementary Schools is part of the construction budget, so financing is folded into the overall municipal bond for the project.
- For other projects, we have in the past and now are required by code to make school buildings solar ready. This includes preparation for electrical requirements, space considerations for equipment, roof structure capacity validation, empty conduit runs for future wiring, and designating the area on the roof to accommodate the solar array(s). These costs are also built into the financing of the school building.
- This allows the Owner to add PV in the future that could be financed by a municipal bond or purchased through a PPA, We've assisted clients in the past pursuing grants to help fund PV on their buildings.
- When we assessed the cost of PV versus operational savings, we included the cost of bond financing in our analysis and we included projected increases in electricity rates based on DOE projections. The payback analysis in the presentation was simplified so that it was comparable to the other schools.
- The more complex analysis shows that purchasing PV protects the town from rising energy costs. To pay for PV, the town had to borrow additional money and pay additional interest. In return, the town would incur no energy costs for the school. Municipal construction bonds are often the lowest rates possible in the market - much lower than commercial rates and lower that the predicted inflation rate for energy.

Are there any resources available to help calculate the solar payback for ownership vs a PPA for a school?

- For our projects, we often hire a solar energy consultant or sometimes our engineers to provide this kind of analysis. The design engineers need to be involved at a certain level no matter who's doing the full financial analysis because they are the most familiar with the energy consumption of the building. This is often easier when an energy model is created.
- There are organizations like Energy Sage who offer both the option to purchase or enter into a PPA: https://www.energysage.com/about/who-we-are. Also, town financial and facilities departments (when it's a municipality installing the solar power) may have the expertise to assist with portions of this analysis or at least contribute to it.

Was the solar done under a PPA or purchased by the owner as a part of the project?

- PV system at Fales Elementary School is owned by the town. They chose to do this at the start, so we did not get estimates for a PPA.

How are you compensating for the seasonal production of the solar with a different building energy load profile in the winter?

- Fales Elementary School will be on the grid, drawing energy as needed for night time and seasonal production variances. The net energy use will be zero annually, with excess energy sent to the grid in the summer and supplemental energy supplied by the grid in the winter, nighttime, etc.

- The PV production models account for historical weather patterns. To be conservative, the consultant did not include any generation for January or February to account for the real possibility of zero production from a snow covered roof. Remember winter 2015?
- The "net" in net-zero is in reference to an annual measurement of energy production and consumption.

Have you explored battery storage for the PV system?

- Battery storage capable of making the building off-grid is cost prohibitive at the moment (i.e. storing enough energy to operate for several weeks for very low production months).
- We explored using battery storage for emergency power (i.e. code required operation if the grid is down) and it was much more costly than a propane powered generator. Hopefully battery technology will come down in price to the point where it is affordable. As a side note, because the only gas load was associated with intermittent use of an emergency generator, the utility chose not to provide gas to the building because there wasn't enough financial incentive for them to do so.

Is the local utility company willing to give you a time of day pricing?

- The contract with the utility company is not finalized – they require the project to be within 12 months of start of service. The building will be on-line in September 2021. Excess energy will be credited towards the town's utility account to pay for energy use at other town facilities. It's not clear if this will be calculated in dollars, with fixed rates for energy consumed or produced, or if this will be an energy credit.
- It sounds like the question is what is paid for the electricity going back into the grid that is generated by the building facility. The incentive program in Massachusetts reimburses the net metered electricity based on the system size. The reimbursements price structure also declines at a fixed rate over time with each new round of participants. The program is called the Solar Massachusetts Renewable Target (SMART) program.

Why was the Fales school PV so expensive? $3,514 per kW is high.

- The cost shown is the budget estimated by the Construction Manager in late design stages, not a price quoted by an installer:
    - It includes markups beyond the sub-contractor cost.
    - It is a conservative number that is likely to come down in a competitive bidding environment. We needed the budget to accounted for unknown, unforeseeable expenses to ensure that we could keep the PV in the project.

  - There are items needed for this installation that may not be applicable in other scenarios, such as customized connections to the structural deck.
  - The project will carry some cost of work outside of the site for utility upgrades needed to manage net metering. This amount is not known yet, but could be considerable.
- We will update our information once we have bids in hand and know the full cost of system requirements from the utility company.
- Also, this is a typical budget for larger PV systems in Massachusetts often described as the cost per watt. In this case it would be $3.51/watt.

Even if the school is net-zero don't you still need to use grid energy at times when solar is not producing enough?

- Fales Elementary School will be connected to the grid and will use net metering. The energy use will be zero on an annual basis, with excess energy sent to the grid in the summer and supplemental energy supplied by the grid in the winter, nighttime, etc.
- This is why planning early is important. Grid interconnection agreements with utilities can take time. In some more unique instances, typically in urban areas, the structure of the grid offsite will not allow any export of the renewable energy on site. Also, many incentive programs have limitations to the number of participants. Checking to verify there are openings or capacity in the program are important.

Do you pay a net-zero premium on electricity rates because of this?

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- Rate structures for municipal buildings are often applicable to all municipal facilities in the same town. But it likely varies from location to location.

What about emergency generation?

- The school will use a propane generator for code required emergency power. We explored using battery storage, but the cost was too high. Interestingly, we originally planned on natural gas, but our use was limited to backup heat and generator, so the utility declined to provide service to the site.

Are you seeing any stratification issues with high ceilings for the clearstory design?

- Ventilation is a displacement system. Fresh air is delivered low in the room (4' tall registers, 4" off the floor). Return air registers are at the top of the clerestory monitors (and elsewhere). Displacement ventilation air moves slowly through the space and actually relies upon air stratification for it to work properly - hot air rising and exhausting and cooler fresh air coming in low.

Has the team found predictive modeling tools used to be accurate?

- We have found the predictive models to be fairly accurate, but they are never exact. A few factors come into play:
- Towns tend to use new buildings more than the old ones they replaced. Our energy use model accounted for this to some degree by anticipating off hours use:
    - Recreational use of the gym to 10:00 pm, including weekends and summers.
    - After school and summer camp use of the cafeteria, media center, art room, music room, and maker space.
    - One wing of the building scheduled for summer school.
- Building management systems, lighting controls, etc. need fine tuning during the first few years of use. Having data collection equipment throughout the system is important – allowing targeted tweaks to improve energy efficiency. Facilities staff needs to be trained, understand how the system works, and actively manage it. Based on our experience with this client on other projects, we think they will be exemplary.
- Building users need to be educated on how systems work in order to achieve maximum energy efficiency. We provide support materials for this training, but it takes a commitment to continue the education and monitor how people are doing things.
- Energy use varies by year – due to weather and use factors. 3-5 years of data will tell you more than 1 year.

Is there a measurement and verification plan for the project? Will there be a follow up to represent actual energy production and use?

- The school will be collecting lots of data and is eager to share it. We haven't established a measurement and verification plan per se, but that's a good suggestion. We'll do our best to get the information out there so that people can see the difference between predicted and actual energy use and PV production. We won't have anything substantial to share until 2023.

What about Food Service and DHW Heat Pumps? All Electric?

- Food service is all electric. DHW is heated via a heat exchanger connected to the geothermal system, so essentially all electric, but not a resistance electric hot water heater.